# PATENT ABSTRACTS OF JAPAN

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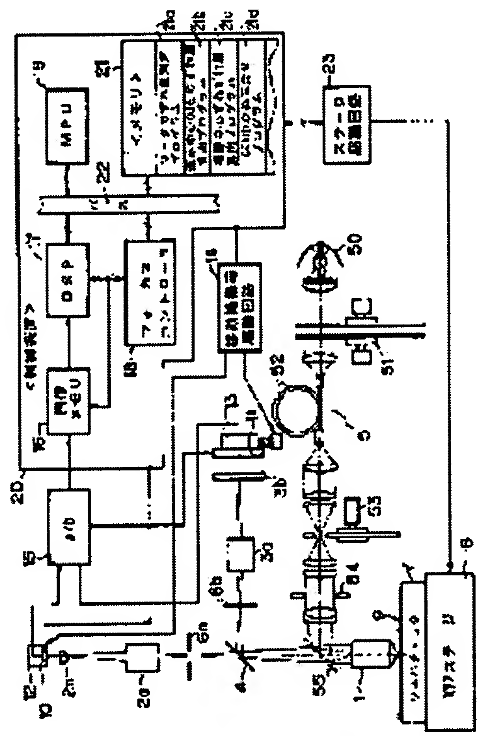
## (54) ADJUSTING METHOD FOR POSITION DEVIATION MEASURING OPTICAL SYSTEM AND POSITION DEVIATION MEASURING APPARATUS

(57)Abstract:

PURPOSE: To obtain a deviation value near the original deviation of an optical system, without being influenced by its distortion, by rotating the same position deviation measuring pattern by 180° and taking a half of the difference from the deviation before rotating.

CONSTITUTION: MPU 19 executes a deviation measuring program 21a about a mark pattern, thereby measuring the deviation $\Delta a$ of a registration pattern on a wafer 9. The wafer 9 is rotated by 180° to measure the deviation $\Delta r$ of this pattern. The true mark deviation $\delta$ is computed according to $\delta=(\Delta a-\Delta r)/2$. A linear shifter 13 is controlled to move the detection center of a detector by a field of view corresponding to the deviation $\delta$ whereby this detection center can be aligned with the original center of an optical system.



LEGAL STATUS

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CLAIMS

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[Claim(s)]
[Claim 1] It has the detector which generates the detecting signal which the center is positioned in the center of a visual field, receives the light from the amount measurement pattern of position gaps, and expresses the amount of position gaps. In the adjustment method of the measuring beam study system in the amount measuring device of position gaps which measures the amount of position gaps by the aforementioned detecting signal Have the move mechanism to which the detection center of the aforementioned detector is moved, and the amount of shears which measured and obtained the amount of gaps of the aforementioned amount measurement pattern of position gaps is made into the 1st amount of gaps. Rotate the 180 degrees of this amount measurement pattern of position gaps, and the amount of shears which measured and obtained the amount of gaps is made into the 2nd amount of gaps. The adjustment method of the amount measuring beam study system of position gaps to which the difference of the amount of gaps of the above 1st and the amount of gaps of the above 2nd is acquired as 3rd amount of gaps, and the center of the aforementioned detector is moved by the visual field corresponding to the amount of gaps of the above 3rd according to the aforementioned move mechanism according to this 3rd amount of gaps.
[Claim 2] The amount of gaps of the above 3rd is the adjustment method of the amount measuring beam study system of position gaps according to claim 1 which is 1/2 of the difference of the amount of gaps of the above 1st, and the amount of gaps the above 2nd.
[Claim 3] The amount measuring device of position gaps which is characterized by providing the following and which has the detector which generates the detecting signal which the center is positioned in the center of a visual field, receives the light from the amount measurement pattern of position gaps, and expresses the amount of position gaps, and measures the amount of position gaps by the aforementioned detecting signal. The move mechanism to which the detection center of the aforementioned detector is moved. An amount measurement means of gaps to measure the amount of gaps of the aforementioned amount measurement pattern of position gaps as 1st amount of gaps, and to make rotate the 180 degrees of this amount measurement pattern of position gaps, and to measure the amount of gaps as 2nd amount of gaps. A means to compute one half of the differences of the amount of gaps of the above 1st, and the amount of gaps of the above 2nd as 3rd amount of gaps. The move means to which the aforementioned move mechanism is controlled according to the amount of gaps of the above 3rd, and the center of the aforementioned detector is moved by the visual field corresponding to the amount of gaps of the above 3rd.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] The mutual amount of position gaps of various kinds of patterns with which this invention was formed on the wafer, It is related with the adjustment method of the measuring beam study system of the amount measuring device of position gaps and the amount measuring device of position gaps which measure the so-called registration. in detail In a certain semiconductor manufacturing process It is related with the adjustment method of the measuring beam study system of the amount measuring device of position gaps which can measure the amount of position gaps with the pattern which is a process in front of the resist pattern formed of exposure through the mask etc., and its one, and was already formed, which is, and with which it **********ed with high precision.
[0002]
[Description of the Prior Art] In manufacture of a semiconductor IC, various kinds of patterns are formed to the wafer of a substrate with a smooth front face. Since these patterns need to form a mutual position correctly, the mutual amount of position gaps and the so-called registration are precisely measured between the formed pattern and the pattern formed in a degree. Corresponding to the fast increase in the storage capacity of 64M, 256M, and DRAM, measurement inspection of this amount of position gaps is becoming increasingly important from 16M.
[0003] In order to manufacture DRAM with high-density storage capacity, it is important that adjustment of the detection optical system of an aligner, and the center of detection optical system and the center of each chip on a wafer are positioned with high precision. Alignment of this conventional positioning is carried out so that these may be in agreement with a laser beam in the center of detectors, such as a center of the field of a wafer, a center of the objective lens of the optical system of an aligner, a relay lens, and CCD that detects an alignment mark.
[0004]
[Problem(s) to be Solved by the Invention] However, if the storage capacity of DRAM becomes the density beyond 16M, since the line breadth as a pattern will be set to 0.7 micrometers or less, the allowable error in registration is set to 15nm or less, and there is a problem which cannot attain the precision asked for the distortion error of optical system by influencing only by adjustment of the conventional optical system. The purpose of this invention is to solve the trouble of such conventional technology and offer the adjustment method of the amount measuring beam study system of position gaps and the amount measuring device of position gaps which can measure the amount of position gaps with high precision.
[0005]
[Means for Solving the Problem] The feature of the adjustment method of the amount measuring beam study system of position gaps of this invention It has the detector which generates the detecting signal which the center is positioned in the center of a visual field, receives the light from the amount measurement pattern of position gaps, and expresses the amount of position gaps. In the adjustment method of the measuring beam study system in the amount measuring device of position gaps which measures the amount of position gaps by the detecting signal Have the move mechanism to which the detection center of a detector is moved, and the amount of shears which measured and obtained the amount of gaps of the amount measurement pattern of position gaps is made into the 1st amount of gaps. Rotate the 180 degrees of this amount measurement pattern of position gaps, and the amount of shears which measured and obtained the amount of gaps is made into the 2nd amount of gaps. One half of the differences of the 1st amount of gaps and the 2nd amount of gaps, for example, this difference, is obtained as 3rd amount of gaps, and the center of a detector is moved by the visual field corresponding to the 3rd amount of gaps according to a move mechanism according to this 3rd amount of gaps. Moreover, the amount measuring device of position gaps of this invention controls the aforementioned move mechanism according to the 3rd amount of gaps, and moves the center of a detector

automatically by the visual field corresponding to the 3rd amount of gaps.
[0006]
[Function] Thus, by rotating the 180 degrees of the same amount measurement patterns of position gaps, shifting, measuring an amount, and taking one half of a difference with the amount of gaps before rotation, especially differences, the value near the original amount of gaps can be acquired as 3rd amount of gaps without being influenced by distortion of optical system. About the principle, it mentions later. Then, the detection center of a detector can be made in agreement with the center of original of optical system by moving the detection center of a detector by the visual field corresponding to the 3rd amount of gaps. Consequently, the measurement error by distortion of optical system is almost lost, and the highly precise amount of gaps can be measured.
[0007]
[Example] Drawing 1 is explanatory drawing of the registration measuring device of one example which applied the adjustment method of the amount measuring beam study system of position gaps this invention. drawing 2 The flow chart of justification processing of an optical-system center and the center of a detector and drawing 3 It shifts from the amount of distortion of a registration pattern. explanatory drawing about a relation with an amount and drawing 4 Explanatory drawing and drawing 5 which can shift point of measurement, shift from a visual field center, and measure an amount Explanatory drawing about a registration pattern and drawing 7 of explanatory drawing of an example of the measurement result in drawing 4 and drawing 6 are explanatory drawings about the chip on a wafer, and arrangement of a registration pattern and the detecting signal of a detector.
[0008] (a) of drawing 6 The example of the registration pattern (mark pattern) 30 which has the resist pattern 30 inside an etching pattern, respectively, and (b) They are the example of the resist pattern **** registration pattern 30, and (c) to the etching pattern bottom. It is the example of the registration pattern 30 which has an etching pattern inside a resist pattern. The bottom shows the plan and the bottom shows the cross section, respectively. These consist of a resist pattern 32 to the etching pattern 31 which are some patterns already formed in the front process, and the pattern to be formed from now on, the square configuration is carried out mutually, and either is arranged inside. Such (a) (b) (c) One of each of the registration pattern 30 is drawing 7 (a). It is symmetrically prepared in four places to the center of a certain chip 24 (arbitrary chips) on a wafer, respectively as registration patterns (mark pattern) 30a, 30b, 30c, and 30d so that it may be shown. These four registration patterns are prepared in the circumference corresponding to each chip, respectively. Drawing 7 (b) Registration pattern 30a detected with a CCD detector in the state of a focus, for example, (b) of drawing 6 , It is the detecting signal (following X-axis detecting signal) of X shaft orientations of a thing. Although the detecting signal of Y shaft orientations also becomes the same wave, it has omitted drawing.
[0009] The peak positions a and d of an X-axis detecting signal are detected, and they are these centers XE. The peak positions b and c are detected and they are these centers XR. Difference deltaX is the amount of gaps of the direction of X. If this amount of gaps is in tolerance, the position of the resist pattern 32 will conform, the resist which makes this resist pattern 32 a part will be used as a mask, and the following pattern will be formed. The above will form the resist pattern again same a line crack and after shifting the wafer after removing a resist, and the mask, offsetting by the amount, when delta X or delta Y had become [ in / ** one shaft orientations / are, rub and ] out of range / of an allowed value /, and carrying out alignment again by exposure also to Y shaft orientations.
[0010] By the way, the detectors which receive the optical reflected light in order to detect such an amount of gaps are the CCD linear sensor 10 of X shaft orientations of drawing 1 , and the CCD linear sensor 11 of Y shaft orientations. On the other hand, when the center of the detector of the center of an objective lens 1, relay lenses 2a and 3a, and CCD 10 and 11 is adjusted according to a laser beam like before, there is a gap at the center of the visual field determined with optical system, such as the objective lens system 1, relay lens 2a and cylindrical-lens 2b (X shaft orientations), relay lens 3a, and cylindrical-lens 3b (Y shaft orientations), and the center of actual optical system. This gap is generated according to the outer-diameter precision of a lens, a process tolerance, an attachment state, and the adjustment state of optical system. Of course, the center of the visual field by this optical system and the center of the CCD linear sensors 10 and 11 which are detectors shall be in agreement by the present adjustment here.
[0011] 4 is a one-way mirror and divides the reflected light from a wafer into the detection system of the direction of X, and the direction of Y. 5 is lighting optical system and consists of the light source 50, the quantity of light compensation filter 51 and the fiber 52 prepared in the middle of the optical-path optical path, the drawing mechanism 53 in which lighting light is extracted, a field diaphragm 54 and a one-way mirror 55, and a lens system that generates condensing or parallel light prepared corresponding to each [ these ] element. In addition, 6a and 6b are the visual field setting adjustable slits of the direction of X prepared before relay lenses 2a and 3a, respectively, and the direction of Y, and the XYZ move stage where 7 moves to a wafer chuck and 8 moves the wafer chuck 7 in the XYZ direction, and 9 are the wafers by which the chuck was carried out to the wafer chuck 7.

[0012] As shown in drawing 3 , generally distortion increases the distortion of optical system from an optical-system center by the quadratic curve. usually, the conventional adjustment -- an optical-system center (this is called center of distortion in order to distinguish from the center of a visual field below) -- visual field center Os from -- it has shifted Center Od of this distortion Center Os of a visual field If the amount of gaps becomes large, however it may perform high adjustment of precision, highly precise registration measurement cannot be performed. center Od of distortion Center Os of a visual field ** -- it is because gap ********** will perform registration measurement in the large place of distortion On the other hand, it is the center Od of this distortion. If it is made in agreement with the center of the detection system of the CCD linear sensors 10 and 11, also in the conventional adjustment, the center of a detection system and optical system is in agreement, there will be little distortion and highly precise measurement can be performed.
[0013] Then, in drawing 1 , the linear move mechanisms 12 and 13 of the direction of X to which the position of the CCD linear sensors 10 and 11 is moved, and the direction of Y are established. A control unit 20 is the distortion center Od of optical system. It asks for a position and control which controls the drive circuits 14, such as these move mechanisms 12 and 13 and a move mechanism, and makes the center of the CCD linear sensors 10 and 11 in agreement with the center of distortion is carried out. The A/D-conversion circuit (A/D) 15 is controlled by the control unit 20, digitizes the detecting signal of the CCD linear sensors 10 and 11, and sends it out to a control unit 20.
[0014] A control unit 20 consists of an image memory 16, a digital signal processor (DSP) 17, a focal controller 18, MPU19, and memory 21 grade, and MPU19, DSP17, the focal controller 18, and the memory 21 grade are mutually connected through the bus 22. A/D15 receives the detecting signal from the CCD linear sensors 10 and 11, and sends out the data which carried out A/D conversion by the predetermined sampling period to an image memory 16. An image memory 16 memorizes the data from A/D15 one by one.
[0015] It is controlled by MPU19, the digital data of an image memory 16 is received, and DSP17 is drawing 7 (b) after this. The shown aforementioned amount of gaps deltaX (deltaY) is computed at high speed, and a calculation result is sent out to MPU19. This is a processor only for the amount calculation of gaps. The focal controller 18 is controlled by MPU19, controls the CCD linear sensors 10 and 11, A/D15, and an image memory 16, moves the XYZ move stage 8 to a Z direction in response to the data from an image memory 16, and performs focusing. In addition, about this focusing processing, since it is not directly related to invention, it omits. In memory 21, they are amount measurement program of gaps 21a of a mark, and the distortion center Od. Amount calculation program of gaps 21b, amount calculation program of visual field center gap gaps 21c, CCD center position doubling program 21d, etc. are prepared. 23 is a stage drive circuit which sends out the driving signal which moves the XYZ move stage 8 in the direction of X, Y, and Z according to the control signal from a control unit 20 to the XYZ move stage 8.
[0016] Hereafter, it is distorted according to drawing 2 and is Center Od. Alignment processing with the center of a detector is explained focusing on X shaft orientations. In addition, since it is the same about Y shaft orientations, except for the case of being required, explanation is omitted especially. first, MPU19 -- amount measurement program of gaps 21a of a mark pattern -- performing -- a certain registration pattern on a wafer 9 (as a mark pattern), for example, drawing 3 , (a) it is shown -- as -- the center of the inside frame 33 of the outside pattern of registration pattern 30a -- visual field center Os of the objective lens system 1 It positions, DSP17 is started and amount of gaps delta[ of registration pattern 30a ] a is measured (Step 100).
[0017] Next, drawing 3 (b) 180 degrees of wafers 9 are rotated and it is in the chip 24 before rotation, and the position of a point symmetry to the center O to registration pattern 30a before rotation on a wafer 9 so that it may be shown. It is the visual field center Os of the objective lens system 1 to the center of the outside inside frame 33 similarly to registration pattern 30a in the circumference of the chip 24 after the rotation shown by the dotted line. Position and DSP17 is started. Amount of gaps deltar of registration pattern 30a is measured (Step 101). And the true amount delta of mark gaps is computed by delta= (deltaa-deltar) / 2. That is, they are delta x and deltay by deltax = (deltaax-deltarx)/2, and deltay = (deltaay-deltary) / 2. It computes (Step 102). Here, it is the visual field center Os of registration pattern 30a. Visual field center Os of registration pattern 30a rotated 180 degrees when the amount of distortion from the optical-system center which can be set was set to Da The amount Dr of distortion of the optical system which can be set also becomes Dr**Da.
[0018] Drawing 3 (a) (b) The graph shown in the bottom explains the state of this distortion, and is (a). Distortion center Od in the visual field at the time of 0 degree which is before rotation The amount D of distortion which shifts, shows the relation with the vector V of an amount, shifts in this case, and joins an amount delta is Od and Os. It is set to Da which is a difference. On the other hand, it is (b). Distortion center Od in the visual field after 180-degree rotation The amount of distortion which shifts, shows the relation with the vector V of an amount, shifts in this case, and joins an amount delta is Od. Os It is set to Dr which is a difference. The direction of Vector V is reversed at 0

degree and 180 degrees, and the length is almost equal. Distortion center Od The amount of distortion of a shell is large at the radial, and the amounts Da and Dr of distortion act mutually to the amounts delta a and delta r of gaps at an opposite direction. And the direction of the amounts delta a and delta r of gaps is also reversed. Then, each length which distortion shifts and is exerted on an amount becomes in the same direction. Namely, if it acts in the direction in which distortion contracts the length to the amount Da of distortion, it acts in the direction which the direction of length is reversed to the amount Dr of distortion, and extends it. Therefore, an operation of the length according [ all ] to distortion becomes in the direction of one side of the subtraction direction or the addition direction.

[0019]

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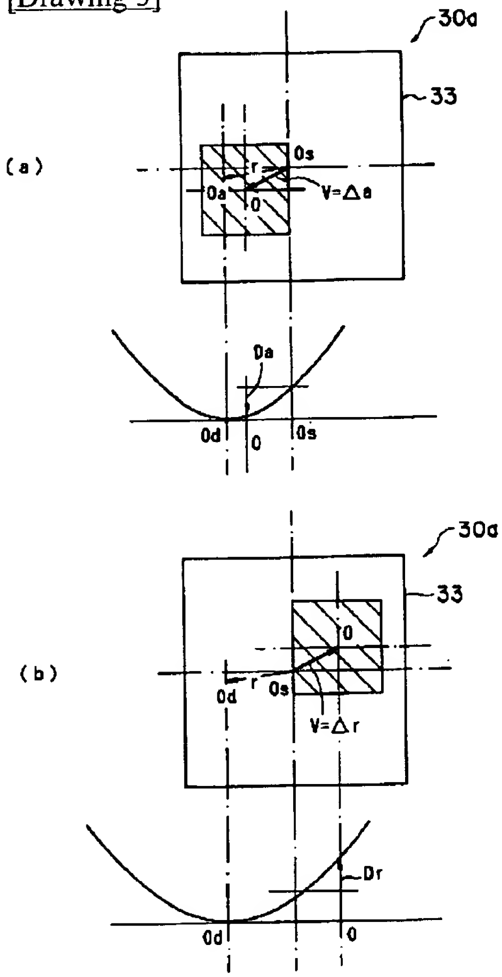
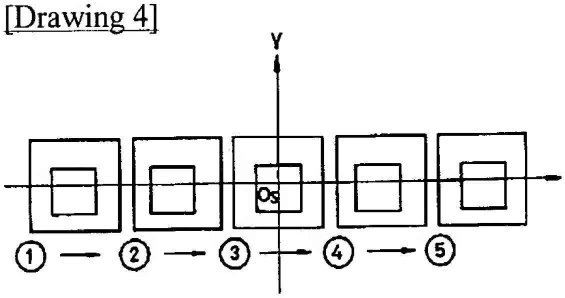
DRAWINGS

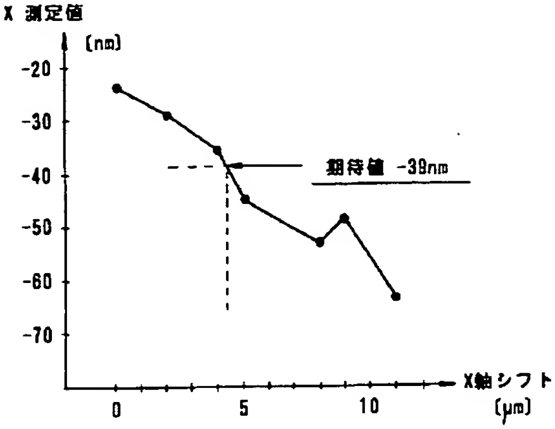
[Drawing 3]



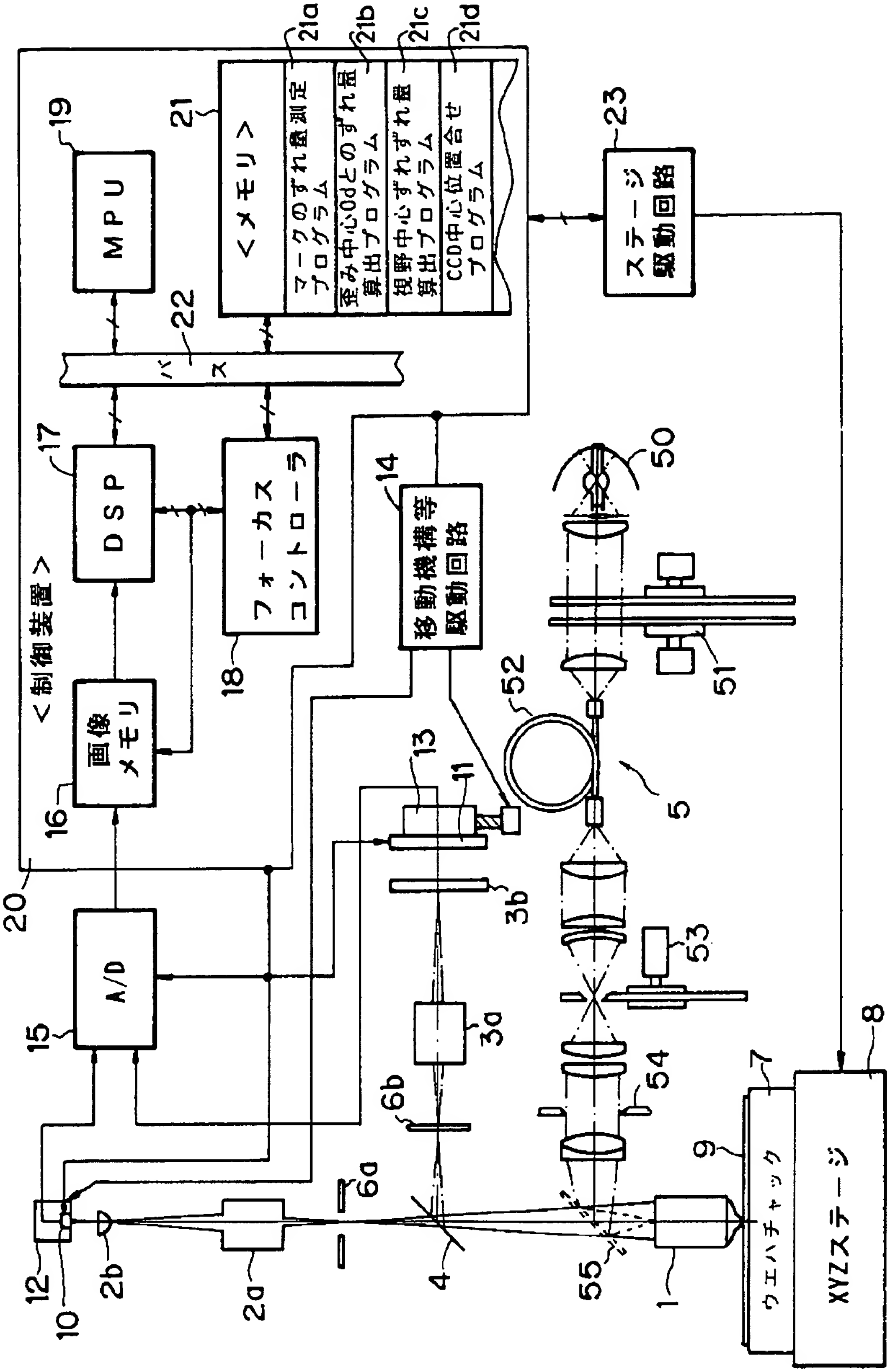

[Drawing 4]



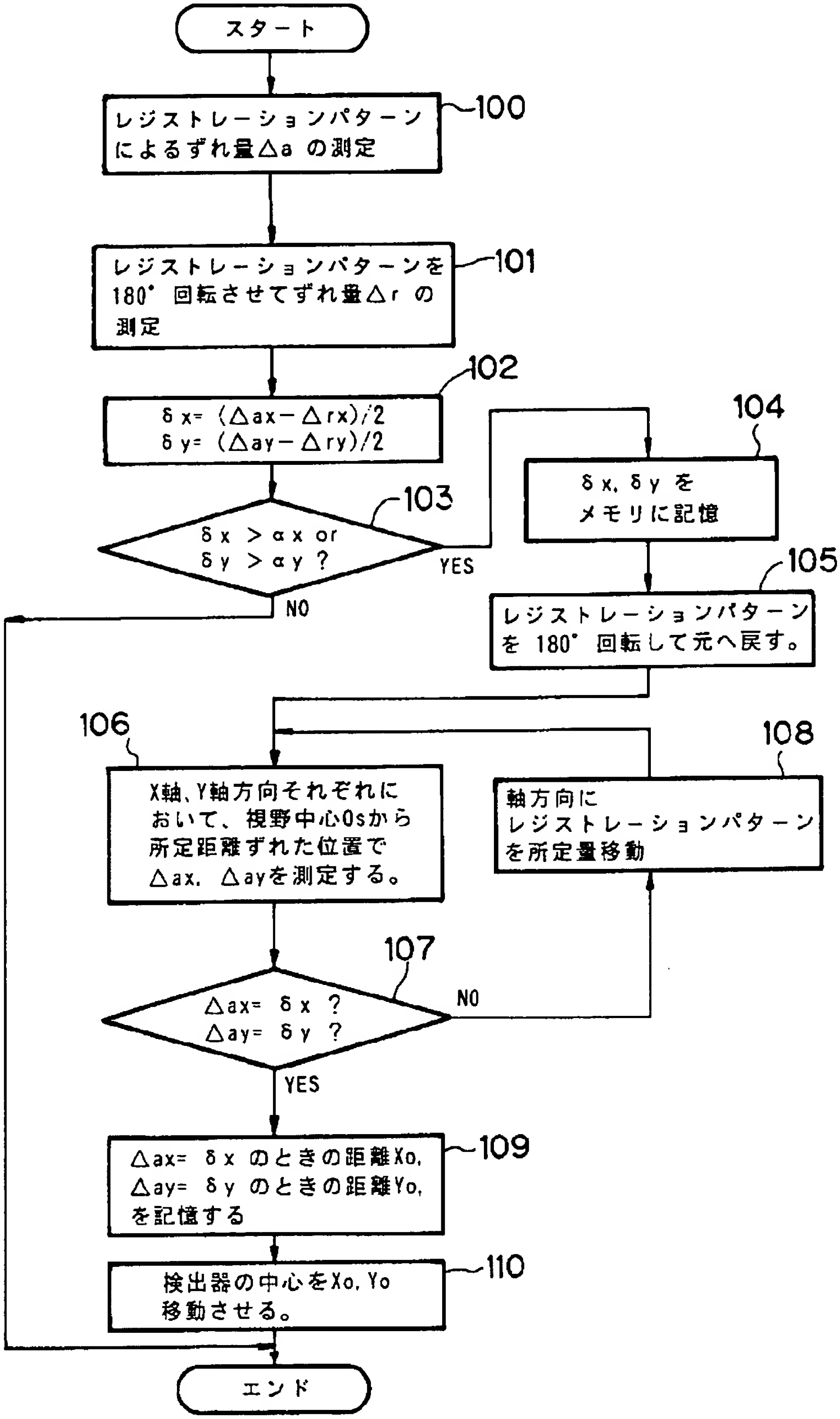

[Drawing 5]




[Drawing 1]

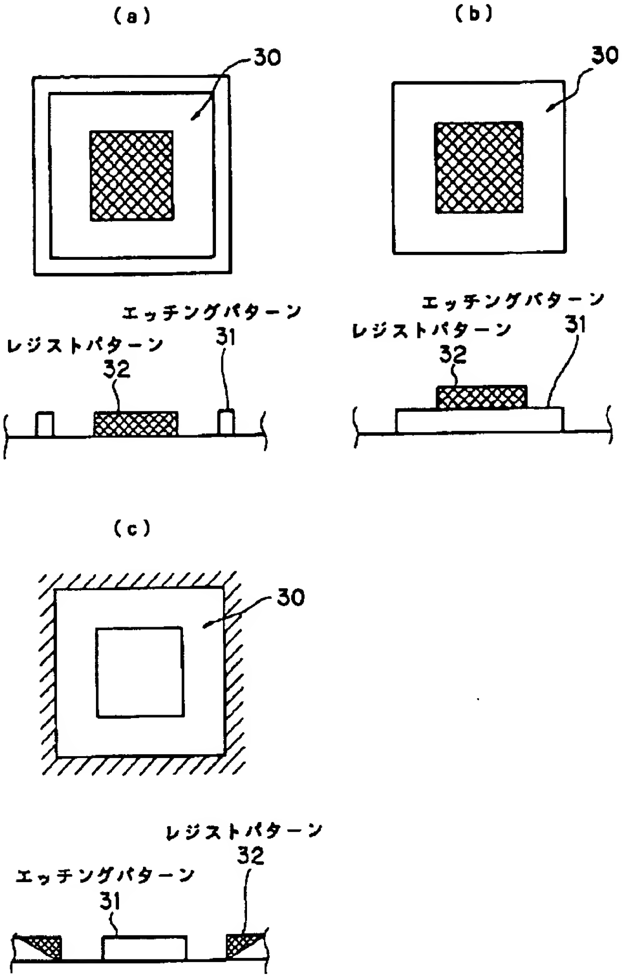

<制御装置>
MPU
DSP
画像メモリ
A/D
フォーカスコントローラ
移動機構等駆動回路
ステージ駆動回路
<メモリ>
マークのずれ量測定プログラム
歪み中心0dとのずれ量算出プログラム
視野中心ずれ量算出プログラム
CCD中心位置合せプログラム
バス
ウエハチャック
XYZステージ
21a
21b
21c
21d
21
19
22
23
17
14
18
16
20
15
13
11
3b
3a
6b
6a
12
10
2b
2a
4
55
1
9
7
8
5
52
51
50
53
54

[Drawing 2]



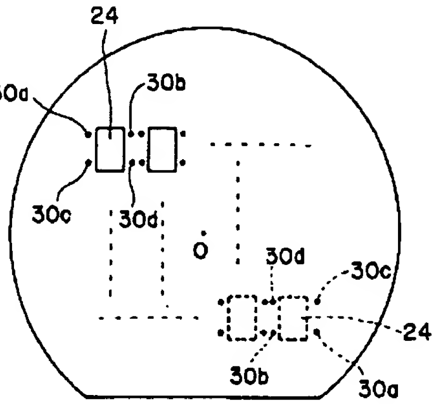
スタート
レジストレーションパターンによるずれ量△a の測定
100
レジストレーションパターンを180° 回転させてずれ量△r の測定
101
δx= (△ax−△rx)/2
δy= (△ay−△ry)/2
102
δx ＞αx or
δy ＞αy ?
103
YES
NO
δx, δy を
メモリに記憶
104
レジストレーションパターンを 180° 回転して元へ戻す。
105
X軸、Y軸方向それぞれにおいて、視野中心Osから所定距離ずれた位置で△ax, △ayを測定する。
106
△ax= δx ?
△ay= δy ?
107
NO
YES
軸方向に
レジストレーションパターンを所定量移動
108
△ax= δx のときの距離Xo,
△ay= δy のときの距離Yo,
を記憶する
109
検出器の中心をXo, Yo
移動させる。
110
エンド


[Drawing 6]

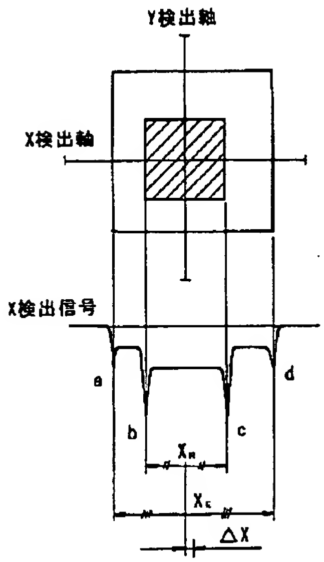

(a)
30
エッチングパターン
31
レジストパターン
32
(b)
30
エッチングパターン
レジストパターン
31
32
(c)
30
レジストパターン
32
エッチングパターン
31

[Drawing 7]

(a)




(b)

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